Insertion Paths for Algorithms and Software in Climate Models

1. Money
2. Time
3. Quality

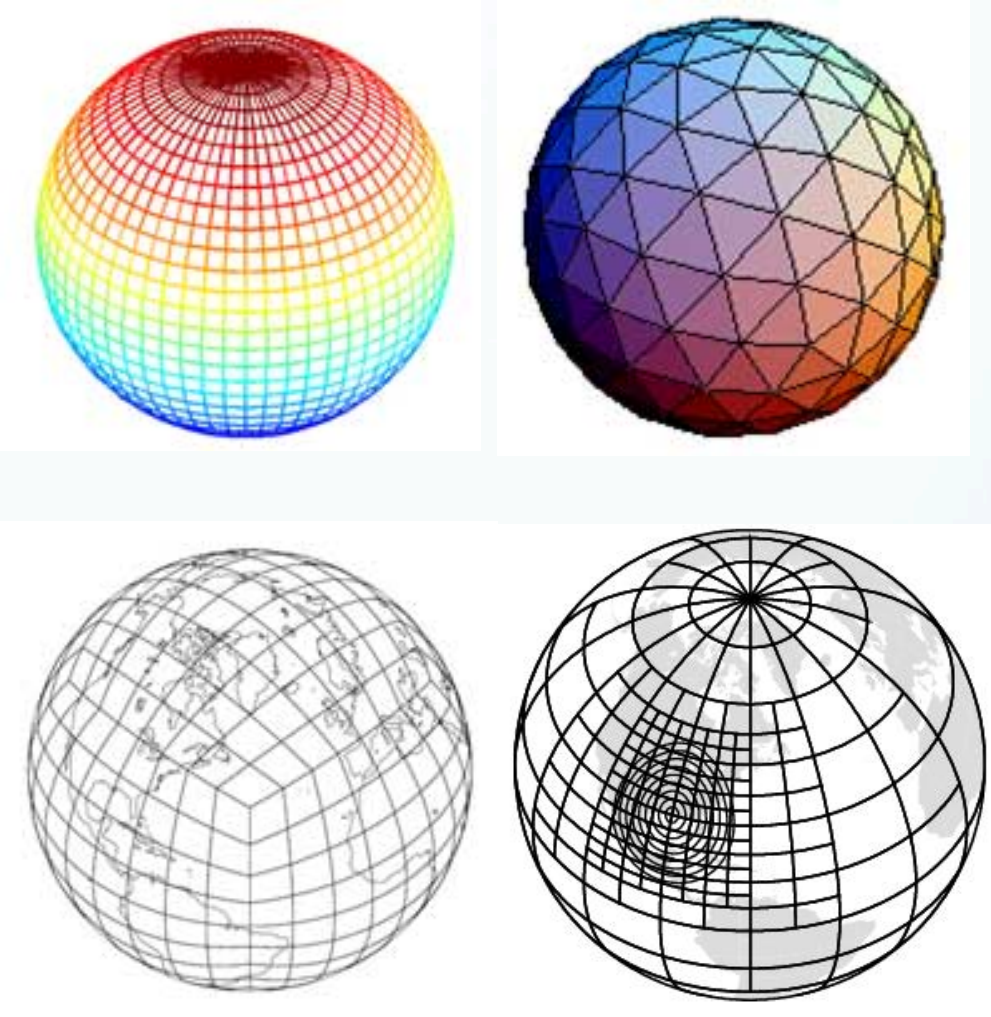
Pick two.

"We did that 10 years ago."

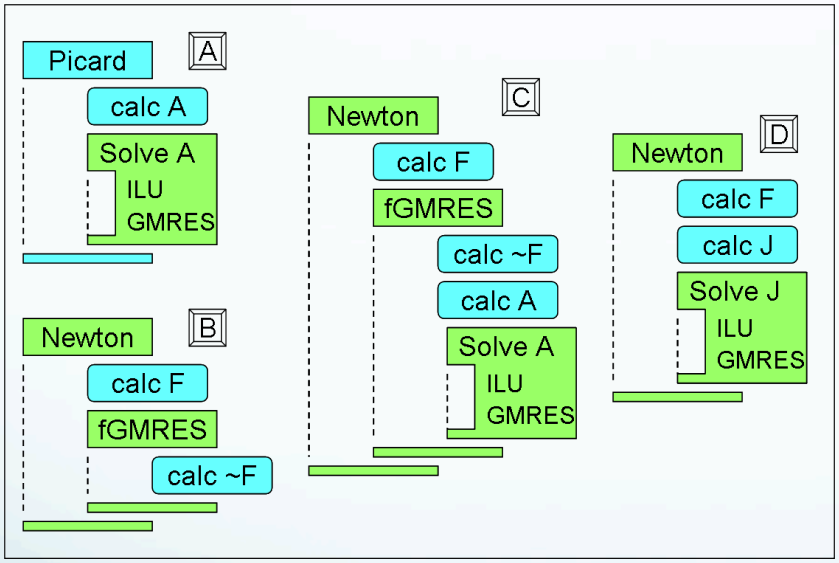
"Sounds untested for our kind of complex application."

Challenges for insertion/development in Earth System models: Complexity

- 1M lines of code, 5 components exchanging fluxes through a coupler
- Individual dycores with unique meshes and discretization (both time and space)
- Different priorities among focus areas
  - Chemists want monotonicity/conservation, dynamicists want accuracy
  - Ice modelers want minimum 50 year runs
  - Causality of bias (atm says its land, vice versa)



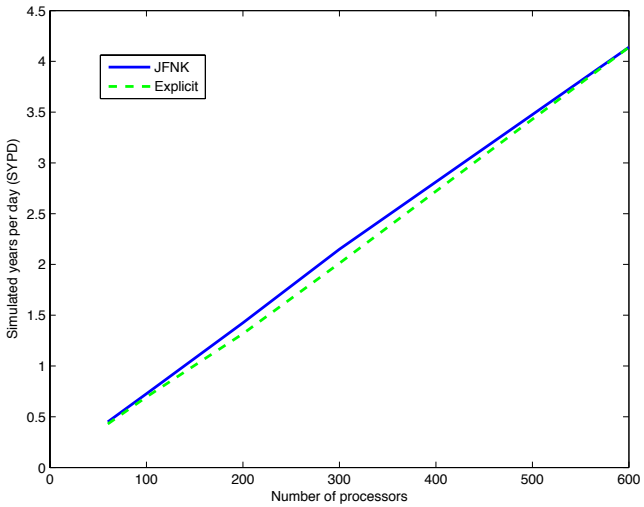
Challenges for insertion/development in Earth System models: Numerical

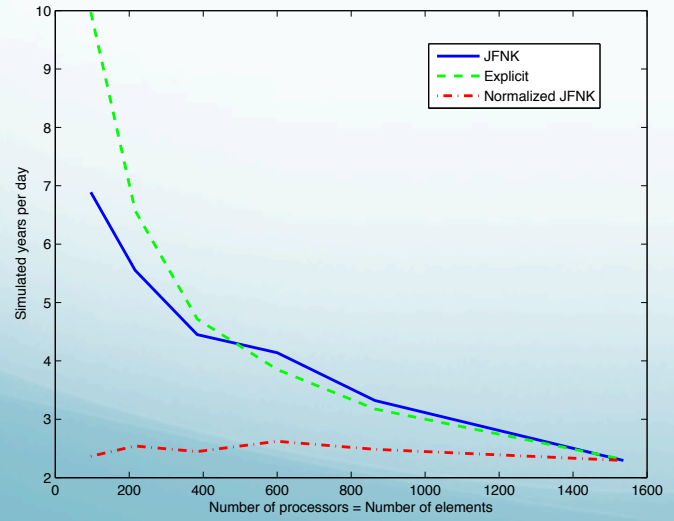


Example interface to Trilinos
In Glimmer-CISM Fortran90 code

- Individual dycores with unique scales.
  - Deep water currents ~1K years
  - Atmosphere/Land ~diurnal cycle
- New general interface should allow quick prototyping for solver development
- Preconditioner still requires problem specific development in each dycore
- Solver parameters must be evaluated for each component

Challenges for insertion/development in Earth System models: Cultural





- 5 components have different developer teams (diversity)
- Knowledge about application not in the same space as knowledge about multiphysics issues (education/interaction)
- Prove methodology with test suites. Good and Bad

Challenges for insertion/development in Earth System models: Practical

- Learning curve for new staff, postdocs
  - Learn numerical methods
  - Learn problem physics
  - **Highly complex software packages**
  - Learning multiple languages/interoperability
  - Porting/building/testing codes on LCF platforms
- Needed areas of expertise seem to grow with time